

SEMI-ANNUAL PROGRESS REPORT

NASA GRANT NsG-692

September 1, 1967 through February 29, 1968

Experiments With Ultraviolet Light

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FACILITY FORM 602	N 68 - 86895	_____
	(ACCESSION NUMBER)	(THRU)
	6	NONE
	(PAGES)	(CODE)
	CR - 95840	_____
	(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)

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April 16, 1968

The results of earlier work done under this grant, which were described in previous semi-annual reports, were published in the following article appearing in the September 15, 1967 issue of The Physical Review: "Generation of Light by the Relative Motion of COntiguous Surfaces of Mercury and Glass," Gay L. Dybwad and C. E. Mandeville, Phys. Rev. 161, 527 (1967). Ten reprints of the article are enclosed with this report. Twenty seven written requests for reprints of this publication have been received to this date.

A paper describing the research reported in the preceding semi-annual report was presented at the American Physical Society meeting held in Chicago on January 29, 1968. (Gay L. Dybwad and C. E. Mandeville, Bull. Am. Phys. Soc. 13, 128 (1968).) An article describing the research is being prepared for publication.

Microwave equipment (antenna, detector, and adjustable short) tuned to a wavelength of 2.3 mm was purchased, and an attempt was made to observe radiation from rotational transitions of carbon monoxide, which is present in many of the mercury filled glass spheres used in these experiments. With the present equipment, no such radiation could be detected, indicating that the radiation has an intensity less than 10^{-7} watts. Three centimeter microwave equipment was borrowed from the electrical engineering department. It also showed an emission intensity of less than 10^{-7} watts.

The mercury-glass glow effect, which is the subject of these experiments, is dependent upon the trapping of electrons on the glass surface. The rotation of the ball separates these electrons from the then positively charged mercury pool. Light is emitted

when the electrons jump back to the pool, colliding with residual gas atoms in their path on their way. Research has been conducted in the last six months which demonstrates an alternative non-radiative path of return for the electrons. When the glass sphere is rotated very slowly, some of the electrons on the glass surface leak back to the mercury pool via surface conduction. When the surface is an excellent insulator and very little surface conduction takes place, a graph of the ultraviolet emission intensity in Geiger counts per minute versus the rotation rate is linear, as in Fig. 1. When surface conduction occurs, deviations from a straight line are obtained. Figure 2 shows such a departure from linearity. The reduction in intensity is caused by depletion of electronic charge on portions of the glass surface due to surface conduction. The ratio of the observed intensity to that predicted by a linear relation gives the percentage of the active area of the spinning ball which has a low enough surface conductivity relative to the rotation rate for a discharge to occur. This percentage is graphed in Fig. 3; it represents the probability distribution function of the conductivities on the surface. The derivative of this curve gives the probability density curve as a function of the rotation rate; this is

represented by the dashed line in Fig. 3. Wide variations (four orders of magnitude) in the surface conductivity of glass have been observed. As might be expected, this surface conductivity is very sensitive to the state of cleanliness of the surface.

Signed John D. Spangler
Date 29 April 1968

FIG. 1

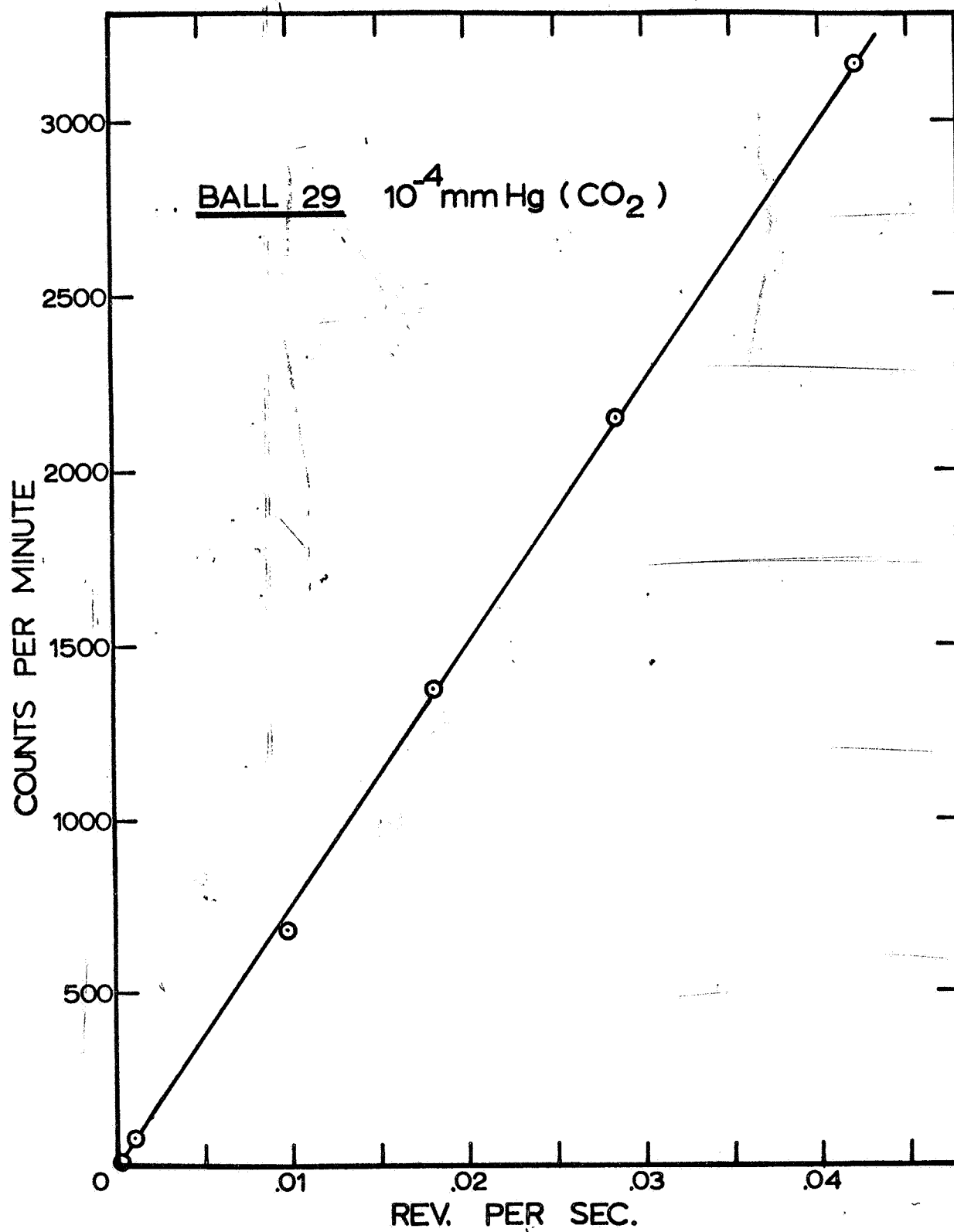
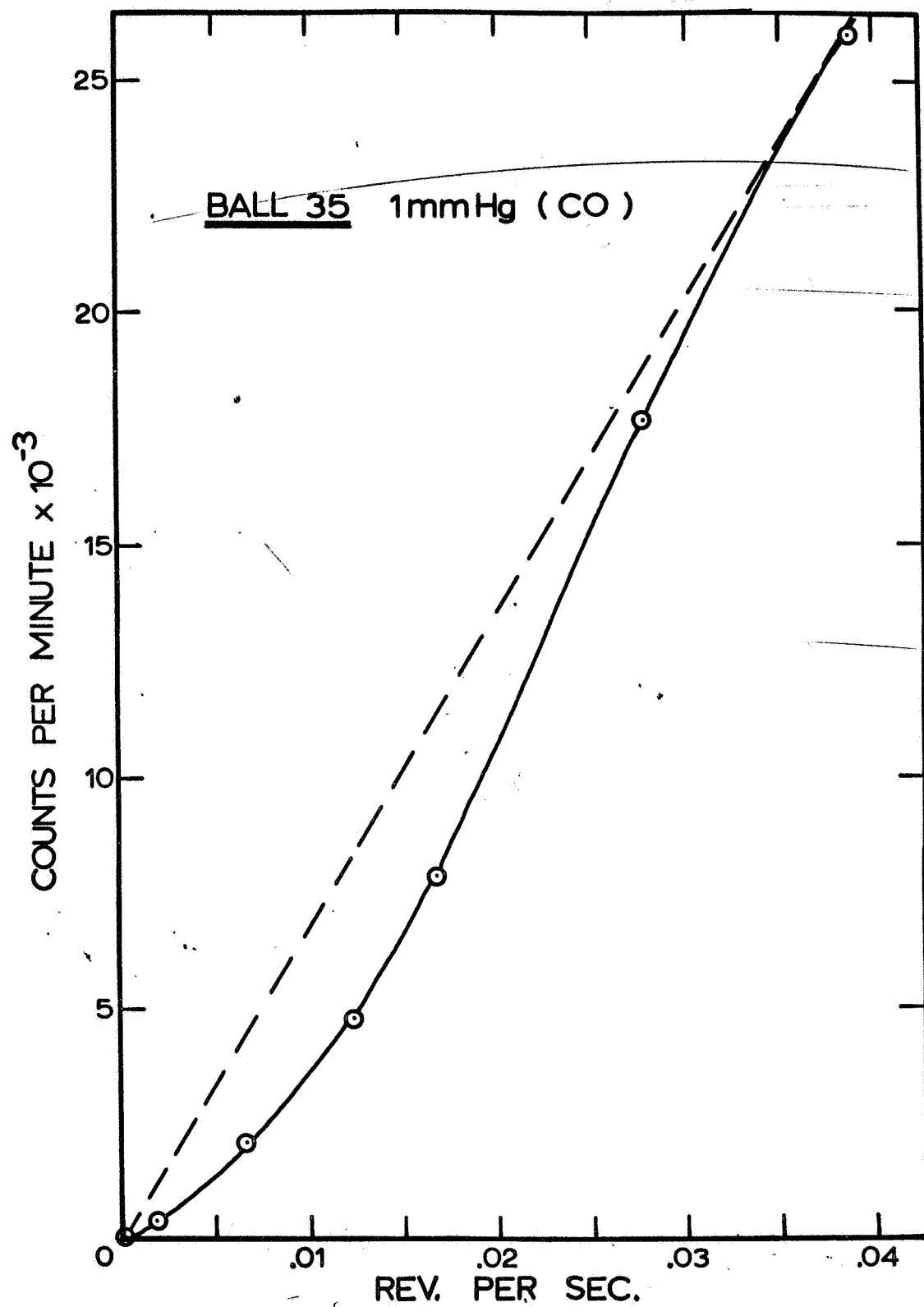


FIG. 2



BALL 35 PERCENT OF SURFACE
WITH CHARGE

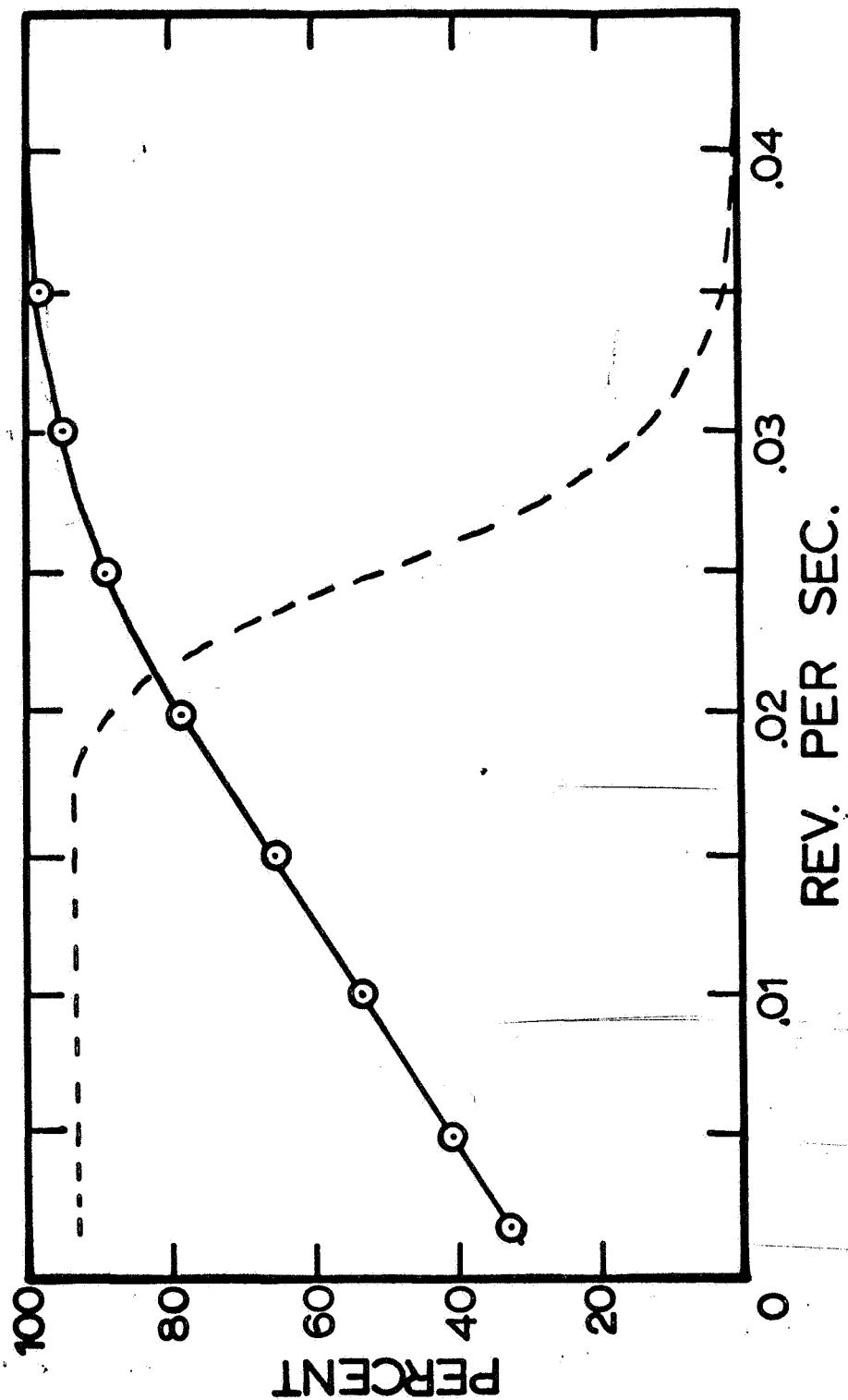


Fig. 3